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Han

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(54) **PATTERNING SLIT SHEET FRAME ASSEMBLY**

(71) Applicant: **Jeong-Won Han**, Yongin (KR)

(72) Inventor: **Jeong-Won Han**, Yongin (KR)

(73) Assignee: **SAMSUNG DISPLAY CO., LTD.**, Yongin, Gyunggi-Do (KR)

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(51) **Int. Cl.**

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H01L 51/56	(2006.01)
H01L 27/00	(2006.01)
C23C 14/04	(2006.01)
H01L 27/12	(2006.01)

(52) **U.S. Cl.**

CPC ***C23C 14/042*** (2013.01); *B05C 21/005* (2013.01); *H01L 27/124* (2013.01); *H01L 27/1259* (2013.01); *H01L 51/56* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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Primary Examiner — Dah-Wei D Yuan
Assistant Examiner — Jethro M Pence
(74) *Attorney, Agent, or Firm* — Lee & Morse, P.C.

(57) **ABSTRACT**

A patterning slit sheet frame assembly includes a patterning slit sheet having a pattern, a patterning slit sheet frame supporting the patterning slit sheet, and a tensile force application unit that applies a tensile force to the patterning slit sheet after the patterning slit sheet is disposed on the patterning slit sheet frame.

19 Claims, 7 Drawing Sheets

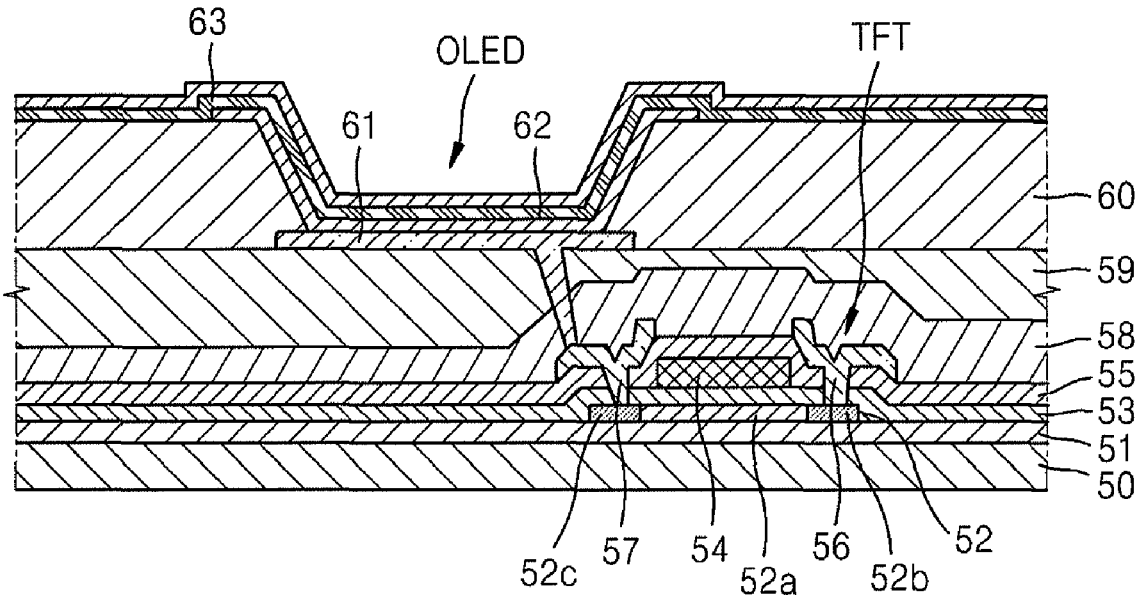


FIG. 1

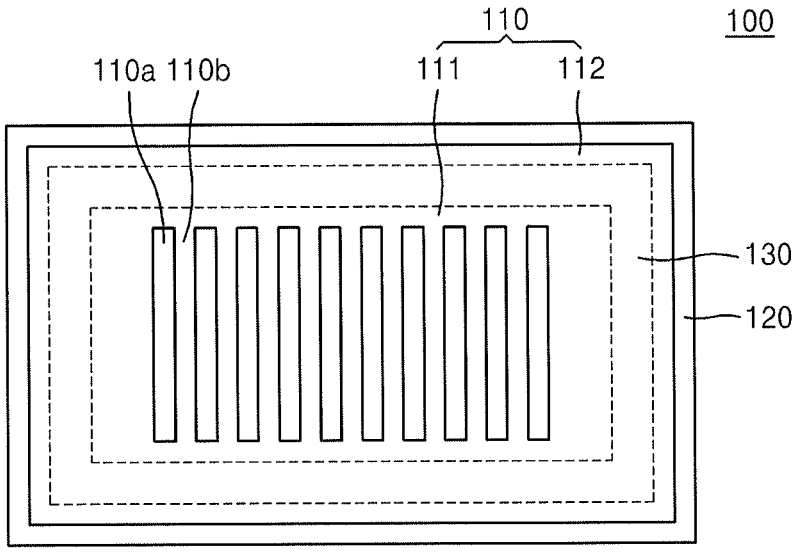

110
100
110a 110b
111
112
130
120

FIG. 2

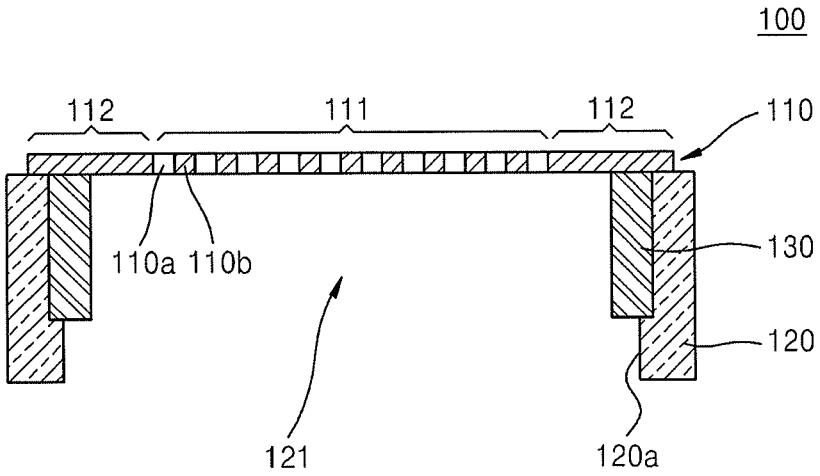

100
112
111
112
110
110a 110b
130
120
121
120a

FIG. 3

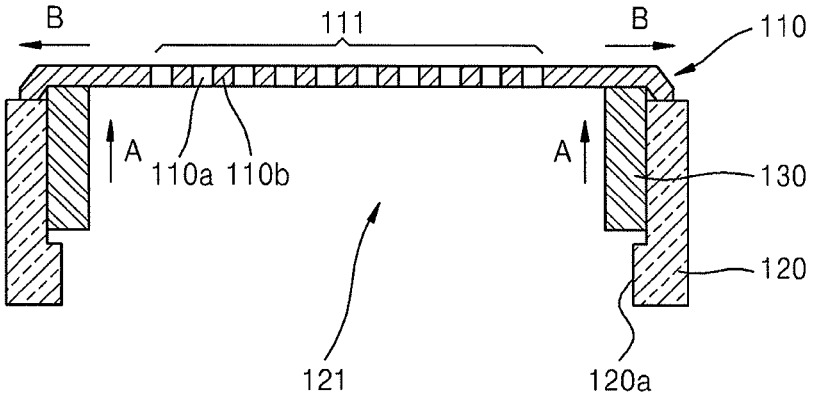


FIG. 4

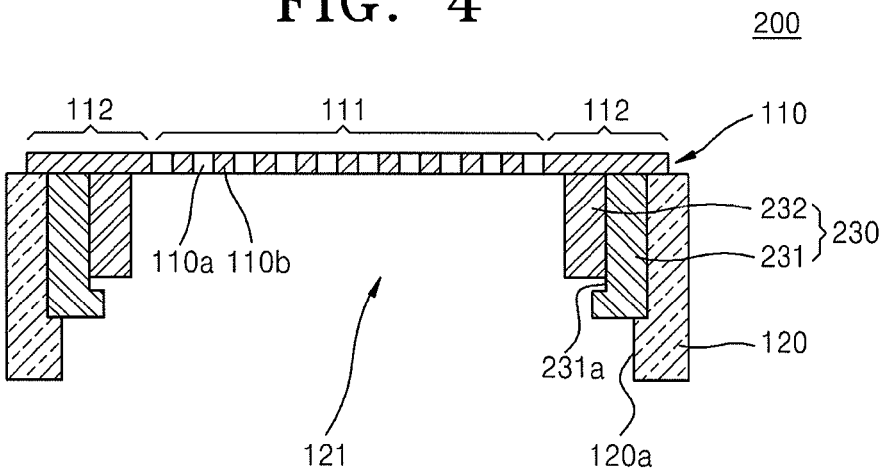


FIG. 5

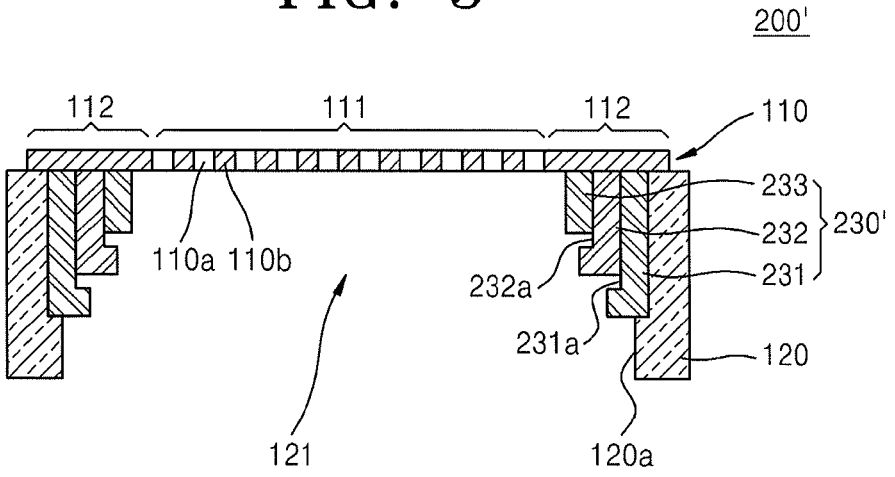


FIG. 6

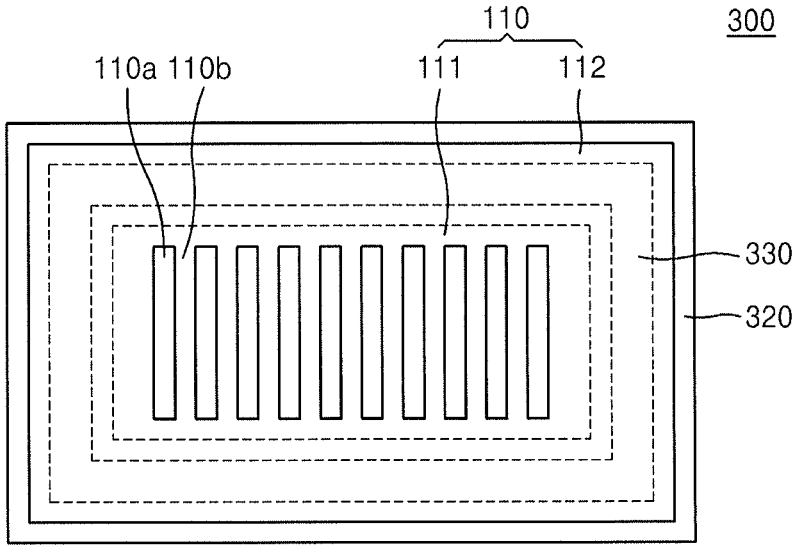

110
300
110a 110b
111
112
330
320

FIG. 7

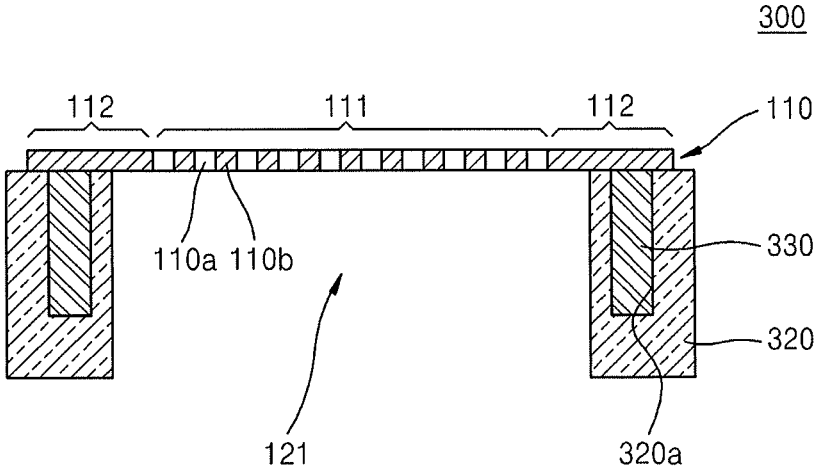

300
112
111
112
110
110a 110b
330
320
121
320a

FIG. 8

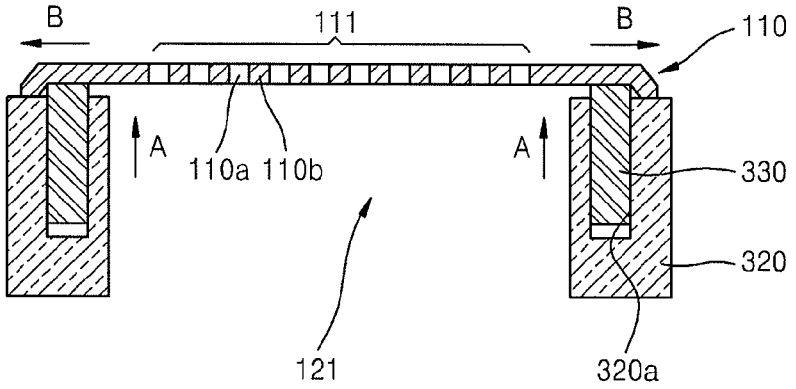


FIG. 9

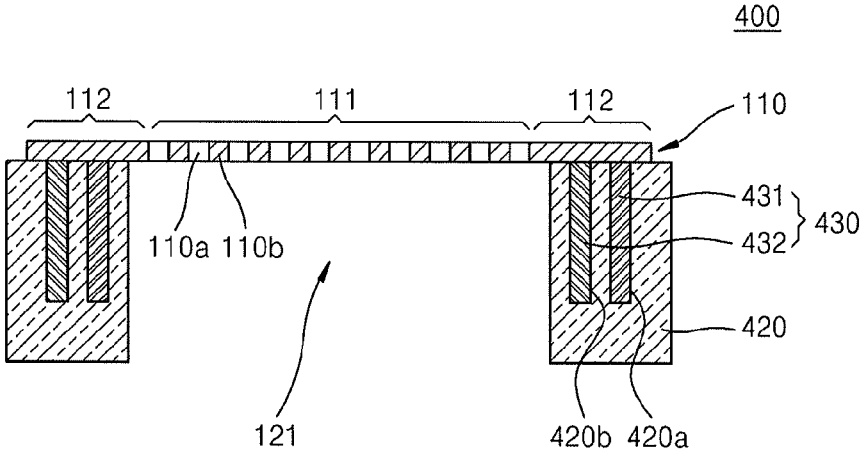


FIG. 10

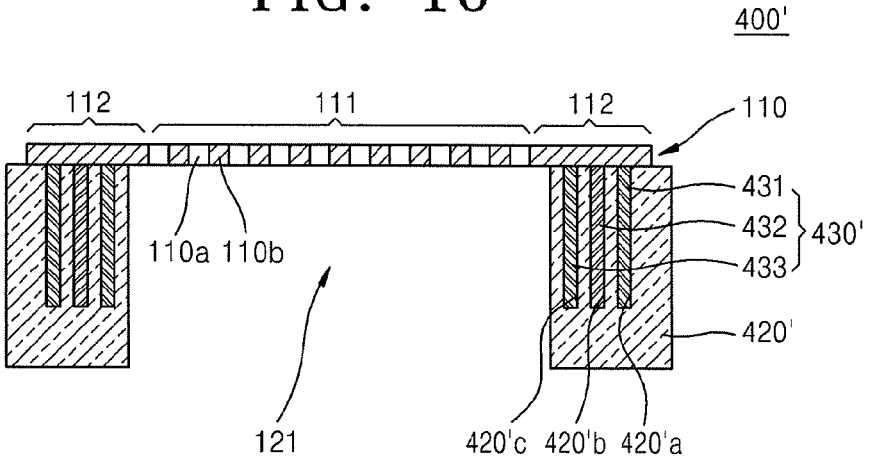


FIG. 11

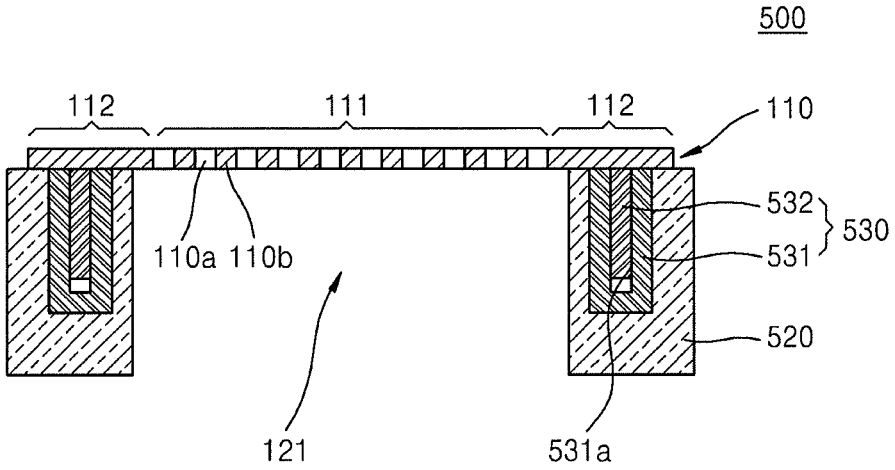

500
112
111
112
110
532
530
531
110a 110b
520
121
531a

FIG. 12

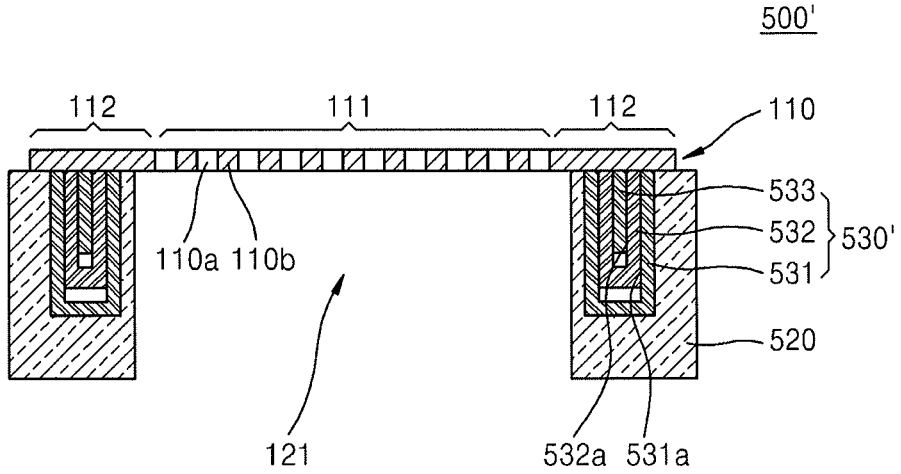

500'
112
111
112
110
533
532
530'
531
110a 110b
520
121
532a 531a

FIG. 13

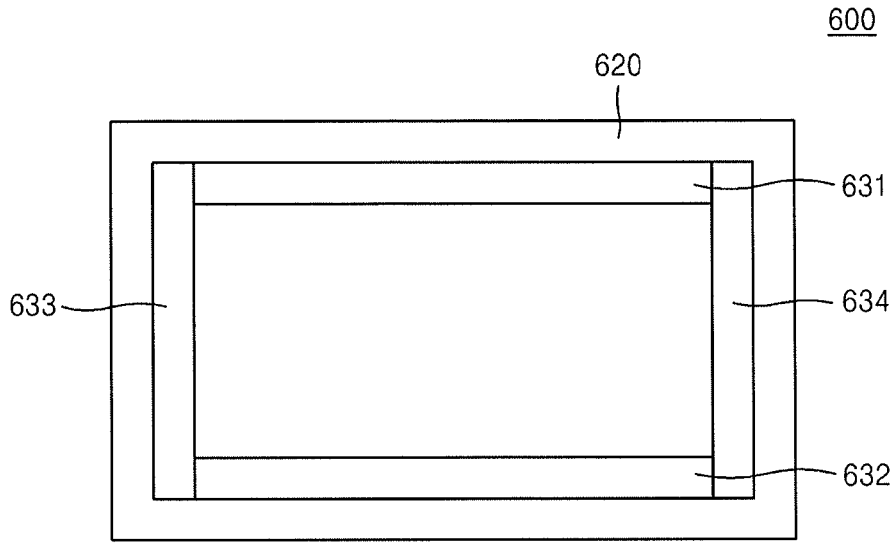

600
620
631
633
634
632

FIG. 14

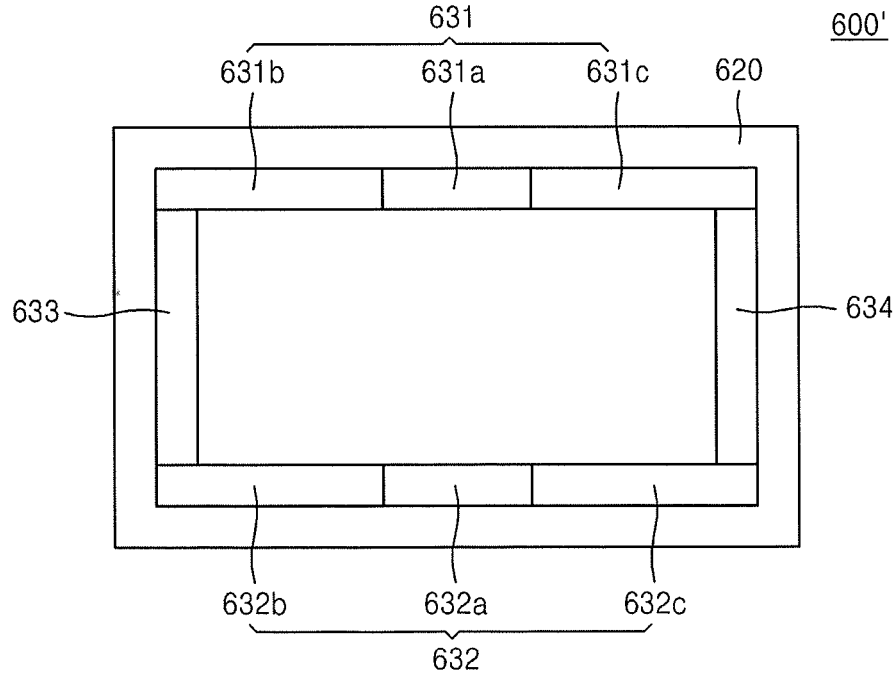
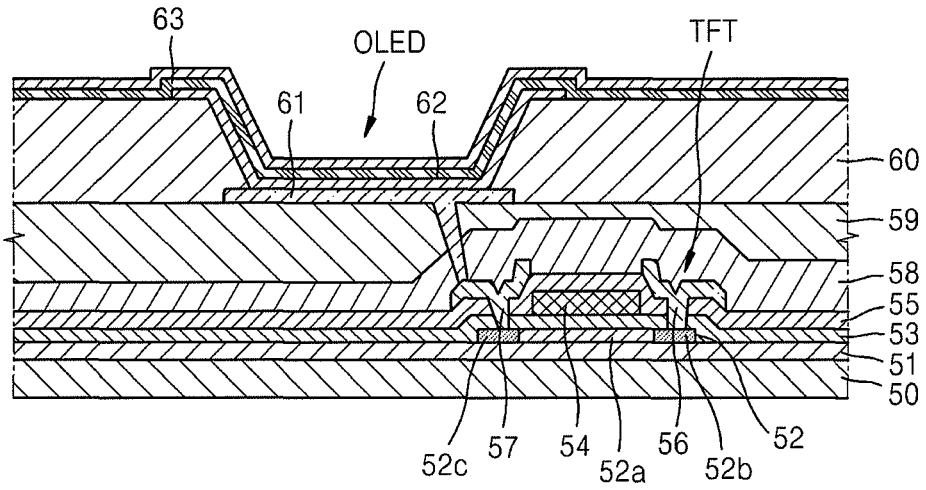

631
600'
631b
631a
631c
620
633
634
632b
632a
632c
632

FIG. 15



PATTERNING SLIT SHEET FRAME ASSEMBLY

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This application claims priority under 35 U.S.C. §119 to Korean Patent Application No. 10-2012-0129102, filed on Nov. 14, 2012, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

Organic light emitting display apparatuses, from among display apparatuses, may have wide viewing angles, excellent contrasts, and quick response speeds.

SUMMARY

Embodiments may be realized by providing a patterning slit sheet frame assembly that includes a patterning slit sheet having a pattern, a patterning slit sheet frame supporting the patterning slit sheet, and a tensile force application unit that applies a tensile force to the patterning slit sheet after the patterning slit sheet is disposed on the patterning slit sheet frame.

The patterning slit sheet may include a center portion where a patterning slit is formed and an outer portion where a pattern is not formed. The patterning slit sheet may be disposed on the patterning slit sheet frame as the outer portion is welded to the patterning slit sheet frame. The tensile force application unit may be disposed on an inner side of the patterning slit sheet frame.

The tensile force application unit may be disposed closer to the center portion than a location where the patterning slit sheet and the patterning slit sheet frame are welded. The tensile force application unit may contact the outer portion to surround the center portion of the patterning slit sheet. The tensile force application unit may move towards a top of the patterning slit sheet to apply the tensile force to the patterning slit sheet while the patterning slit sheet and the pattering slit sheet frame are connected to each other.

The patterning slit sheet frame may have a pillar shape having a penetrating portion corresponding to the center portion. A top surface of the patterning slit sheet frame may be combined connected to the outer portion, and the center portion may be exposed by the penetrating portion. The tensile force application unit may be disposed on an inner surface of the patterning slit sheet frame such that a top surface of the tensile force application unit contacts the outer portion.

The tensile force application unit may ascend or descend along the inner surface of the patterning slit sheet frame. The tensile force application unit may apply the tensile force to the patterning slit sheet by ascending along the inner surface of the patterning slit sheet frame.

There may be n tensile force application units, where n is a natural number, wherein the (n)th tensile force application unit may be disposed on an inner surface of the (n−1) th tensile force application unit. The patterning slit sheet frame may include an accommodation groove so as to accommodate the tensile force application unit therein.

The tensile force application unit may be disposed inside the accommodation groove and the accommodation groove may be covered by the outer portion. The tensile force application unit may ascend or descend inside the accommodation groove, and the tensile force may be applied to tighten the patterning slit sheet as the tensile force application unit ascends and protrudes outside the accommodation groove.

There may be a plurality of the accommodation grooves and the tensile force application unit may be disposed in each of the plurality of accommodation grooves. The plurality of accommodation grooves may be spaced apart from each other in a receding direction from a center point of the patterning slit sheet.

There may be a plurality of the tensile force application units, and each of the plurality of tensile force application units may include an accommodation portion for accommodating the other tensile force application unit. The tensile force application unit may be formed separately on the inner surface of the patterning slit sheet frame.

There may be n tensile force application units, wherein n is a natural number, wherein the first tensile force application unit may be accommodated in the accommodation groove, the second tensile force application unit may be accommodated in the accommodation portion of the first tensile force application unit, and the (n)th tensile force application unit may be accommodated in the accommodation portion of the (n−1)th tensile force application unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Features will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. **1** is a plan view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **2** is a cross-sectional view schematically illustrating the patterning slit sheet frame assembly of FIG. **1**;

FIG. **3** is a cross-sectional view of a patterning slit sheet frame assembly wherein a tensile force is applied to a patterning slit sheet;

FIG. **4** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **5** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **6** is a plan view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **7** is a cross-sectional view schematically illustrating the patterning slit sheet frame assembly of FIG. **6**;

FIG. **8** is a cross-sectional view of a patterning slit sheet frame assembly wherein a tensile force is applied to a patterning slit sheet;

FIG. **9** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **10** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **11** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **12** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **13** is a plan view schematically illustrating a patterning slit sheet frame assembly according to an embodiment;

FIG. **14** is a plan view schematically illustrating a patterning slit sheet frame assembly according to an embodiment; and

FIG. **15** is a cross-sectional view schematically illustrating an organic light emitting display apparatus manufactured by using a patterning slit sheet frame assembly, according to an embodiment.

DETAILED DESCRIPTION

Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey exemplary implementations to those skilled in the art.

FIG. **1** is a plan view schematically illustrating a patterning slit sheet frame assembly **100** according to an embodiment, and FIG. **2** is a cross-sectional view schematically illustrating the patterning slit sheet frame assembly **100** of FIG. **1**.

Referring to FIGS. **1** and **2**, the patterning slit sheet frame assembly **100** may include a patterning slit sheet **110**, a patterning slit sheet frame **120**, and a tensile force application unit **130**.

The patterning slit sheet **110** may include a center portion **111** and an outer portion **112**.

The center portion **111** may include a plurality of patterning slits **110***a* and a patterning rib **110***b*. The patterning slit **110***a* is an opening penetrating through the patterning slit sheet **110**. A deposition material passes through the patterning slit **110***a* and is deposited on a deposition target, e.g., on a substrate (not shown). A shape of a thin film deposited on the deposition target is determined based on a shape of the patterning slit **110***a*. For example, as shown in FIG. **1**, when the patterning slit **110***a* is rectangular, the thin film deposited on the deposition target may also be rectangular like the patterning slit **110***a*. The patterning slit **110***a* may have any one of various shapes including a rectangle.

The patterning rib **110***b* is arranged between adjacent ones of patterning slits **110***a* and can be regarded as a remainder of the patterning slit sheet **110** after forming the patterning slit **110***a* therein. The patterning rib **110***b* blocks the deposition material discharged from a deposition source, thereby reducing the possibility of and/or preventing the deposition material from being deposited on undesired regions of the deposition target.

The outer portion **112** patterning slit sheet **110** is a portion surrounding the center portion **111**. The patterning slits are not formed in the outer portion **112** so as to be excluded from the outer portion **112**. The outer portion **112** contacts, e.g., is directly attached to, the patterning slit sheet frame **120** and is fixed to the patterning slit sheet frame **120**. The outer portion **112** also contacts the tensile force application unit **130** and is configured to receive, e.g., directly receives, a tensile force by the tensile force application unit **130**, as will be described below.

The patterning slit sheet frame **120** supports and fixes the patterning slit sheet **110**. The patterning slit sheet frame **120** includes a penetrating portion **121** for exposing the center portion **111** of the patterning slit sheet **110**. The outer portion **112** of the patterning slit sheet **110** is disposed on and fixed to a top surface of the patterning slit sheet frame **120**. The patterning slit sheet frame **120** may have an approximate window frame shape, e.g., so as to include an outer frame that surrounds an interior opening that exposes the plurality of patterning slits **110***a*. The patterning slit sheet frame **120** may be fixed to the patterning slit sheet **110** via welding. For example, when the patterning slit sheet **110** is fixed to the patterning slit sheet frame **120** via welding, the tensile force is applied to the patterning slit sheet **110** while welding and fixing the patterning slit sheet **110** to the patterning slit sheet frame **120** so that the patterning slit sheet **110** does not droop (or such that drooping is minimized) and is tightened.

The tensile force application unit **130** is disposed on an inner surface **120***a* of the patterning slit sheet frame **120**, and a top surface of the tensile force application unit **130** contacts the outer portion **112** of the patterning slit sheet **110**. The tensile force application unit **130** contacts the outer portion **112** to surround the center portion **111**, while exposing the center portion **111** through the penetrating portion **121**. Unlike the patterning slit sheet frame **120**, the tensile force application unit **130** is not connected to the patterning slit sheet **110** via welding. For example, the tensile force application unit **130** may directly contact the patterning slit sheet **110** without being affixed to the patterning slit sheet **110**.

The tensile force application unit **130** may ascend or descend along the inner surface **120***a* of the patterning slit sheet frame **120**. As the tensile force application unit **130** ascends along the inner surface **120***a* of the patterning slit sheet frame **120**, the tensile force application unit **130** may provide the tensile force to the patterning slit sheet **110**. For example, the tensile force application unit **130** may provide the tensile force to the patterning slit sheet **110** after the patterning slit sheet **110** is welded and fixed to the patterning slit sheet frame **120**.

Referring to FIG. **3**, the tensile force application unit **130** ascends (direction indicated by arrows A) along the inner surface **120***a* of the patterning slit sheet frame **120** to ascend the outer portion **112** of the patterning slit sheet **110**. Since a periphery of the outer portion **112** of the patterning slit sheet **110** is welded and fixed to the top surface of the patterning slit sheet frame **120**, when the tensile force application unit **130** ascends as described above, the outer portion **112** of the patterning slit sheet **110** ascends while the periphery of the outer portion **112** is fixed. Accordingly, the tensile force is applied to the patterning slit sheet **110** in a direction indicated by arrows B, thereby tightly maintaining the patterning slit sheet **110** and reducing the possibility of the patterning slit sheet **110** drooping due to self-weight.

According to a general mask and a general mask frame, a tensile force cannot be applied to the general mask after the general mask is drawn and fixed, and it may be difficult to apply tensile force while fixing the general mask to the general mask frame. Once the general mask is welded to the general mask frame, the general mask cannot be separated from the general mask frame, and thus a lot of time and high precision are used when initially fixing the general mask to the general mask frame. If the tensile force is incorrectly applied to the general mask, e.g., so that the general mask is crookedly welded to the general mask frame, the general mask and the general mask frame are discarded. Further, the general mask tends to droop downward due to self-weight as a deposition process continues, and thus sizes of opening portions formed on the general mask become non-uniform and pixel position accuracy (PPA) is decreased.

However, according to the patterning slit sheet frame assembly **100** of the current embodiment, the tensile force may be applied to the patterning slit sheet **110** even after the patterning slit sheet **110** is welded and fixed to the patterning slit sheet frame **120**. Accordingly, even when there is a slight problem while initially welding the patterning slit sheet **110** to the patterning slit sheet frame **120**, the patterning slit sheet **110** may be further minutely tightened by additionally applying the tensile force to the patterning slit sheet **110** by using the tensile force application unit **130** after the welding has already been performed. Also, even when the patterning slit

sheet **110** droops due to self-weight and continuous deposition processes, the patterning slit sheet **110** may be again tightened by applying the tensile force to the patterning slit sheet **110** by using the tensile force application unit **130**.

FIG. **4** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly **200** according to another embodiment.

Referring to FIG. **4**, the patterning slit sheet frame assembly **200** according to the present embodiment is different from the patterning slit sheet frame assembly **100** of FIGS. **1** through **3** in that a tensile force application unit **230** includes a first tensile force application unit **231** and a second tensile force application unit **232**. Descriptions of components that are the same as those of the patterning slit sheet frame assembly **100** will not be repeated as they have been described above with reference to FIGS. **1** through **3**.

The tensile force application unit **230** includes the first tensile force application unit **231** and the second tensile force application unit **232**. The first tensile force application unit **231** may be disposed on the inner surface **120***a* of the patterning slit sheet frame **120** and the second tensile force application unit **232** may be disposed on an inner surface **231***a* of the first tensile force application unit **231**. The first tensile force application unit **231** may move up or down along the inner surface **120***a* of the patterning slit sheet frame **120**, and the second tensile force application unit **232** may move up or down along the inner surface **231***a* of the first tensile force application unit **231**. The first and second tensile force application units **231** and **232** may separately move. For example, the first tensile force application unit **231** may first ascend to apply a tensile force to the patterning slit sheet **110** and then the second tensile force application unit **232** may ascend to apply an additional tensile force to the patterning slit sheet **110**.

FIG. **5** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly **200'** according to another embodiment.

Referring to FIG. **5**, the patterning slit sheet frame assembly **200'** according to the current embodiment is different from the patterning slit sheet frame assembly **100** of FIGS. **1** through **3** in that a tensile force application unit **230'** includes the first tensile force application unit **231**, the second tensile force application unit **232**, and a third tensile force application unit **233**. Descriptions of components that are the same as those of the patterning slit sheet frame assembly **100** will not be repeated as they have been described above with reference to FIGS. **1** through **3**.

The tensile force application unit **230'** includes the first tensile force application unit **231**, the second tensile force application unit **232**, and the third tensile force application unit **233**. The first tensile force application unit **231** may be disposed on the inner surface **120***a* of the patterning slit sheet frame **120**, the second tensile force application unit **232** may be disposed on the inner surface **231***a* of the first tensile force application unit **231**, and the third tensile force application unit **233** may be disposed on an inner surface **232***a* of the second tensile force application unit **232**.

The first tensile force application unit **231** may move up or down along the inner surface **120***a* of the patterning slit sheet frame **120**, the second tensile force application unit **232** may move up or down along the inner surface **231***a* of the first tensile force application unit **231**, and the third tensile force application unit **233** may move up or down along the inner surface **232***a* of the second tensile force application unit **232**. The first through third tensile force application unit **231** through **233** may separately move. For example, the first tensile force application unit **231** may first ascend to apply a tensile force to the patterning slit sheet **110**, the second tensile force application unit **232** may ascend next to apply an additional tensile force to the patterning slit sheet **110**, and then the third tensile force application unit **233** may ascend to apply an additional tensile force to the patterning slit sheet **110**.

The number of tensile force application units is not limited and may be n, where n is a natural number. In this case, an (n)th tensile force application unit may be disposed on an inner surface of an (n−1)th tensile force application unit.

FIG. **6** is a plan view schematically illustrating a patterning slit sheet frame assembly **300** according to another embodiment, FIG. **7** is a cross-sectional view schematically illustrating the patterning slit sheet frame assembly **300** of FIG. **6**, and FIG. **8** is a cross-sectional view of the patterning slit sheet frame assembly **300** in which a tensile force is applied to the patterning slit sheet **110**.

The patterning slit sheet frame assembly **300** according to the current embodiment is different from the patterning slit sheet frame assembly **100** of FIGS. **1** through **3** in terms of a patterning slit sheet frame **320** and a tensile force application unit **330**. Descriptions of components that are the same as those of the patterning slit sheet frame assembly **100** will not be repeated as they have been described above with reference to FIGS. **1** through **3**.

Referring to FIGS. **6** and **7**, the tensile force application unit **330** is disposed inside the patterning slit sheet frame **320**. In other words, the patterning slit sheet frame **320** has an accommodation groove **320***a* for accommodating the tensile force application unit **330**. The accommodation groove **320***a* is opened towards a top surface of the patterning slit sheet frame **320**, i.e., towards the patterning slit sheet **110**. The tensile force application unit **330** is disposed inside the accommodation groove **320***a*, and thus the tensile force application unit **330** may ascend to protrude from the accommodation groove **320***a*.

The tensile force application unit **330** may provide a tensile force to the patterning slit sheet **110** by protruding and ascending from the accommodation groove **320***a* of the patterning slit sheet frame **320**. For example, the tensile force may be provided to the patterning slit sheet **110** as the tensile force application unit **330** ascends after an outermost side portion of the patterning slit sheet **110** is welded and fixed to the patterning slit sheet frame **320**.

Referring to FIG. **8**, the tensile force application unit **330** ascends (in the direction indicated by the arrows A) to protrude from the accommodation groove **320***a* of the patterning slit sheet frame **120** while ascending the outer portion **112** of the patterning slit sheet **110**. Since the periphery of the outer portion **112** of the patterning slit sheet **110** is welded and fixed to a top surface of the patterning slit sheet frame **320**, when the tensile force application unit **130** ascends as described above, the outer portion **112** of the patterning slit sheet **110** ascends while the periphery of the outer portion **112** of the patterning slit sheet **110** is fixed. Accordingly, the patterning slit sheet **110** drooped due to self-weight may be tightened as the tensile force is applied to the patterning slit sheet **110** in the direction indicated by the arrows B.

FIG. **9** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly **400** according to another embodiment.

Referring to FIG. **9**, the patterning slit sheet frame assembly **400** according to the current embodiment is different from the patterning slit sheet frame assembly **300** of FIGS. **6** through **8** in that a tensile force application unit **430** includes a first tensile force application unit **431** and a second tensile force application unit **432**, which are respectively accommo-

dated in a first accommodation groove **420***a* and a second accommodation groove **420***b*. Descriptions of components that are the same as those of the patterning slit sheet frame assembly **300** will not be repeated as they have been described above with reference to FIGS. **6** through **8**.

A patterning slit sheet frame **420** includes the first accommodation groove **420***a* and the second accommodation groove **420***b*. The first accommodation groove **420***a* is formed farther from a center of the patterning slit sheet **110** than the second accommodation groove **420***b*. The first accommodation groove **420***a* and the second accommodation groove **420***b* are opened towards a top surface of the patterning slit sheet frame **420**, i.e., towards the patterning slit sheet **110**. The first tensile force application unit **431** may be disposed in the first accommodation groove **420***a* and the second tensile force application unit **432** may be disposed in the second accommodation groove **420***b* such that the first and second tensile force application units **431** and **432** ascend to protrude from the first and second accommodation grooves **420***a* and **420***b*. The first and second tensile force application units **431** and **432** may separately move. For example, the first tensile force application unit **431** may first ascend to apply a tensile force to the patterning slit sheet **110**, and then the second tensile force application unit **432** may ascend to apply an additional tensile force to the patterning slit sheet **110**.

FIG. **10** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly **400'** according to another embodiment.

Referring to FIG. **10**, the patterning slit sheet frame assembly **400'** according to the current embodiment is different from the patterning slit sheet frame assembly **300** of FIGS. **6** through **8** in that the tensile force application unit **430** includes the first tensile force application unit **431**, the second tensile force application unit **432**, and a third tensile force application unit **433**, which are respectively accommodated in a first accommodation groove **420'***a*, a second accommodation groove **420'***b*, and a third accommodation groove **420'***c*. Descriptions of components that are the same as those of the patterning slit sheet frame assembly **300** will not be repeated as they have been described above with reference to FIGS. **6** through **8**.

A patterning slit sheet frame **420'** includes the first accommodation groove **420'***a*, the second accommodation groove **420'***b*, and the third accommodation groove **420'***c*. The first accommodation groove **420'***a* is formed farther from the center of the patterning slit sheet **110** than the second accommodation groove **420'***b*, and the second accommodation groove **420'***b* is formed farther still from the center of the patterning slit sheet **110** than the third accommodation groove **420'***c*. The first accommodation groove **420'***a*, the second accommodation groove **420'***b*, and the third accommodation groove **420'***c* are opened towards the top surface of the patterning slit sheet frame **420**, i.e., towards the patterning slit sheet **110**. The first tensile force application unit **431** is disposed in the first accommodation groove **420'***a*, the second tensile force application unit **432** is disposed in the second accommodation groove **420'***b*, and the third tensile force application unit **433** is disposed in the third accommodation groove **420'***c*.

The first through third tensile force application units **431** through **433** may ascend to protrude from the first through third accommodation grooves **420'***a* through **420'***c*. The first through third tensile force application units **431** through **433** may separately move. For example, the first tensile force application unit **431** may first ascend to apply a tensile force to the patterning slit sheet **110**, and then the second tensile force application unit **432** may ascend to apply an additional tensile force to the patterning slit sheet **110**. Also, the third tensile force application unit **433** may ascend to apply an additional tensile force to the patterning slit sheet **110**.

The number of tensile force application units is not limited and may be n, wherein n is a natural number. In this case, an (n)th tensile force application unit may be disposed closer to a center of a patterning slit sheet than an (n−1)th tensile force application unit.

FIG. **11** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly **500** according to another embodiment.

Referring to FIG. **11**, in the patterning slit sheet frame assembly **500** according to the current embodiment, a plurality of first and second tensile force application units **531** and **532** are disposed in one accommodation groove **520***a*. For example, the first tensile force application unit **531** is disposed in the accommodation groove **520***a* and an accommodation portion **531***a* for accommodating the second tensile force application unit **532** is formed in the first tensile force application unit **531** so that the second tensile force application unit **532** is disposed in the accommodation portion **531***a*.

The first tensile force application unit **531** may ascend to protrude from the accommodation groove **520***a*, and the second tensile force application unit **532** may ascend to protrude from the accommodation portion **531***a*.

A side portion of the patterning slit sheet **110** extending farther than the first tensile force application unit **531** is welded and fixed to a patterning slit sheet frame **520**, and thus a tensile force is applied to the patterning slit sheet **110** as the first tensile force application unit **531** ascends and protrudes from the accommodation groove **520***a*. An additional tensile force is applied to the patterning slit sheet **110** as the second tensile force application unit **532** ascends and protrudes from the accommodation portion **531***a*.

FIG. **12** is a cross-sectional view schematically illustrating a patterning slit sheet frame assembly **500'** according to another embodiment.

The patterning slit sheet frame assembly **500'** of FIG. **12** is different from the patterning slit sheet frame assembly **500** of FIG. **11** as there are three tensile force application units **530'**.

For example, in the patterning slit sheet frame assembly **500'**, the first tensile force application unit **531** is disposed in the accommodation groove **520***a*, the accommodation portion **531***a* for accommodating the second tensile force application unit **532** is formed in a groove within the first tensile force application unit **531**, and an accommodation portion **532***a* for accommodating a third tensile force application unit **533** is formed within a groove in the second tensile force application unit **532**. Accordingly, the second tensile force application unit **532** is disposed in the accommodation portion **531***a* and the third tensile force application unit **533** is disposed on the accommodation portion **532***a*.

The first tensile force application unit **531** may ascend to protrude from the accommodation groove **520***a*, the second tensile force application unit **532** may ascend to protrude from the accommodation portion **531***a*, and the third tensile force application unit **533** may ascend to protrude from the accommodation portion **532***a*.

Since the side portion of the patterning slit sheet **110** extending farther than the first tensile force application unit **531** is welded and fixed to the patterning slit sheet frame **520**, a tensile force is applied to the patterning slit sheet **110** as the first tensile force application unit **531** ascends and protrudes from the accommodation groove **520***a* and an additional tensile force is applied to the patterning slit sheet **110** as the second tensile force application unit **532** ascends and protrudes from the accommodation portion **531***a*. Also, an additional tensile force is applied to the patterning slit sheet **110** as

the third tensile force application unit **533** ascends and protrudes from the accommodation portion **532***a*.

FIG. **13** is a plan view schematically illustrating a patterning slit sheet frame assembly **600** according to another embodiment.

In the patterning slit sheet frame assembly **600** of FIG. **13**, a plurality of first through fourth tensile force application units **631**, **632**, **633**, and **634** are disposed on an inner surface of a patterning slit sheet frame **620**. In other words, the first and second tensile force application units **631** and **632** are respectively disposed on long facing sides of the inner surface of the patterning slit sheet frame **620**, and the third and fourth tensile force application units **633** and **634** are respectively disposed on short facing sides of the inner surface of the patterning slit sheet frame **620**. The first through fourth tensile force application units **631** through **634** may separately or simultaneously ascend along the inner surface of the patterning slit sheet frame **620**. Different tensile forces may be applied to the top, bottom, right, and left of a patterning slit sheet as the first through fourth tensile force application units **631** through **634** separately ascend, and thus the patterning slit sheet may be more precisely controlled.

FIG. **14** is a plan view schematically illustrating a patterning slit sheet frame assembly **600'** according to another embodiment.

The patterning slit sheet frame assembly **600'** of FIG. **14** is different from the patterning slit sheet frame assembly **600** of FIG. **13** as the first and second tensile force application units **631** and **632** respectively include a plurality of first through sixth tensile force application members **631***a*, **631***b*, and **631***c*, and **632***a*, **632***b*, and **632***c*.

Referring to FIG. **14**, the first and second tensile force application units **631** and **632** are disposed on an inner surface of the patterning slit sheet frame **620** while facing each other. The first tensile force application unit **631** includes the first through third tensile force application members **631***a* through **631***c* and the second tensile force application unit **632** includes the fourth through sixth tensile force application members **632***a* through **632***c*. The first through sixth tensile force application members **631***a* through **631***c* and **632***a* through **632***c* may separately ascend to each supply a tensile force to a patterning slit sheet.

FIG. **15** is a cross-sectional view schematically illustrating an organic light emitting display apparatus manufactured by using a patterning slit sheet frame assembly, according to an embodiment.

Referring to FIG. **15**, the organic light emitting display apparatus is an active matrix type and is formed on a substrate **50**. The substrate **50** may be formed of a transparent material, such as a glass material, a plastic material, or a metal material. An insulating film **51**, such as a buffer layer, is formed throughout on the substrate **50**.

A thin film transistor (TFT) and an organic light emitting device (OLED) are formed on the insulating film **51** as shown in FIG. **15**. Here, the organic light emitting device may be regarded as an organic light emitting diode, if necessary.

A semiconductor active layer **52** having a predetermined pattern is formed on a top surface of the insulating film **51**. The semiconductor active layer **52** is embedded by a gate insulating film **53**. The semiconductor active layer **52** may include a p- or n-type semiconductor.

A gate electrode **54** of the TFT is formed at a location of the top surface of the gate insulating film **53** corresponding to the semiconductor active layer **52**. Also, an interlayer insulating film **55** is formed to cover the gate electrode **54**. After the interlayer insulating film **55** is formed, a contact hole is formed by etching the gate insulating film **53** and the interlayer insulating film **55** via an etching process, such as dry etching, to expose some of the semiconductor active layer **52**.

Then, source and drain electrodes **56** and **57** are formed on the interlayer insulating film **55** to contact the semiconductor active layer **52** exposed through the contact hole. A passivation film **58** is formed to cover the source and drain electrodes **56** and **57**, and some of the drain electrode **57** is exposed through an etching process. An individual insulating film **59** may be further formed on the passivation film **58** to planarize the passivation film **58**.

The OLED may be used to display predetermined image information by emitting red, green, and blue lights according to a flow of current, in which a first electrode **61** is formed on the passivation film **58**. The first electrode **61** is electrically connected to the drain electrode **57** of the TFT.

Then, a pixel-defining film **60** is formed to cover the first electrode **61**. After a predetermined opening is formed on the pixel-defining film **60**, an organic layer **63** including an emission layer is formed in a region limited by the predetermined opening. Also, a second electrode **62** is formed on the organic layer **63**.

The pixel-defining film **60** defines pixels, is formed of an organic material, and planarizes a surface of the substrate **50** where the first electrode **61** is formed, specifically, a surface of the individual insulating film **59**.

The first and second electrodes **61** and **62** are insulated from each other, and apply voltages of different polarities to the organic layer **63** including the emission layer for light emission.

The organic layer **63** including the emission layer may be formed of a low molecular weight organic material or a high molecular weight organic material. When the low molecular weight organic material is used, a hole injection layer (HIL), a hole transport layer (HTL), an emission layer (EML), an electron transport layer (ETL), and an electron injection layer (EIL) may be stacked in a single or complex structure. Also, various organic materials may be used, such as copper phthalocyanine (CuPc), N,N'-Di(naphthalene-1-yl)-N,N'-diphenyl-benzidine (NPB), and tris-8-hydroxyquinoline aluminum (Alq3).

For example, the organic layer **63** including the emission layer may be deposited through the patterning slit sheet frame assembly **100** of FIG. **1**. In other words, in an organic layer depositing apparatus including a deposition source radiating a deposition material, a patterning slit sheet facing the deposition source and including a plurality of patterning slits, and a patterning slit sheet frame, the deposition material radiated from the deposition source may pass through the patterning slit of the patterning slit sheet and be deposited on a target substrate after the target substrate is closely disposed to the patterning slit sheet. After forming an organic emission film as such, the second electrode **62** may also be formed via the same deposition process.

The first electrode **61** may operate as an anode and the second electrode **62** may operate as a cathode, or vice versa. The first electrode **61** may be patterned to correspond to a region of each pixel, and the second electrode **62** may be formed to cover all pixels.

The first electrode **61** may be a transparent or reflective electrode. When the first electrode **61** is used as a transparent electrode, indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), or indium oxide (In_2O_3) may be used. When the first electrode **61** is used as a reflective electrode, a reflective layer may be formed by using silver (Ag), magnesium (Mg), aluminum (Al), platinum (Pt), palladium (Pd), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), or a compound thereof, and then a transparent

electrode layer may be formed on the reflective layer by using ITO, IZO, ZnO, or In_2O_3. The first electrode **61** may be formed via a sputtering method and then patterned via a photolithography method.

The second electrode **62** may also be a transparent or reflective electrode. When the second electrode **62** is used as a transparent electrode, the second electrode **62** is used as a cathode, and thus a metal having a low work function, such as lithium (Li), calcium (Ca), lithium fluoride (LiF)/Ca, LiF/Al, Al, Ag, Mg, or a compound thereof, may be deposited to face a direction of the organic layer **63** including the emission layer. Then an auxiliary electrode layer or a bus electrode line may be formed on the metal by using ITO, IZO, ZnO, or In_2O_3. According to another exemplary embodiment, when the second electrode **62** is used as a reflective electrode, Li, Ca, LiF/Ca, LiF/Al, Al, Ag, Mg, or a compound thereof may be deposited throughout an active area including a plurality of pixels. For example, the deposition may be performed in the same manner as in the organic layer **63** including the emission layer.

The patterning slit sheet frame assembly may also be used to deposit an organic or inorganic film or an organic TFT, and may be used to form a film of any one of various materials.

By way of summation and review, organic light emitting display apparatuses realize colors according to a principle that light is emitted as holes and electrons injected into an anode and a cathode recombine in an emission layer. This principle may be realized by a stacked structure where the emission layer is inserted between the anode and the cathode. Further, since it could be difficult to obtain highly efficient light emission in the stacked structure, an intermediate layer, such as at least one of an electron injection layer (EIL), an electron transport layer (ETL), a hole transport layer (HTL), and a hole injection layer (HIL), may be selectively additionally inserted between each electrode and the emission layer.

The electrodes of the organic light emitting display apparatus and the intermediate layers including the emission layer may be formed via any one of various methods, such as a deposition method. To manufacture the organic light emitting display apparatus by using the deposition method, a fine metal patterning slit sheet (e.g., fine metal mask (FMM)) having a same pattern as a thin film to be formed on a substrate may be arranged, and a thin film having the desired pattern is formed by depositing a raw material of the thin film.

Embodiments relate to a patterning slit sheet frame assembly. For example, embodiments relate to a patterning slit sheet frame assembly capable of applying a tensile force to a patterning slit sheet even after the patterning slit sheet is adhered to a patterning slit sheet frame.

According to the one or more embodiments, the tensile force is applied to the patterning slit sheet even after the patterning slit sheet is adhered to the patterning slit sheet frame, and thus the sizes and uniformity of opening portions of the patterning slit sheet and pixel position accuracy (PPA) may be minutely adjusted, and the patterning slit sheet may be protected and/or prevented from drooping.

Exemplary embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. Accordingly, it will be understood by those of ordinary skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

What is claimed is:

1. A method for manufacturing an organic light-emitting display apparatus, the method comprising:

forming a first electrode;

forming an organic layer on the first electrode by depositing organic material through a patterning slit sheet frame assembly, the patterning slit sheet frame assembly including:

a patterning slit sheet having a pattern;

a patterning slit sheet frame supporting the patterning slit sheet; and

a tensile force application unit that applies a tensile force to the patterning slit sheet after the patterning slit sheet is disposed on the patterning slit sheet frame, the tensile force application unit being entirely on an inner side of the patterning slit sheet frame; and

forming a second electrode so that the organic layer is interposed between the first electrode and the second electrode.

2. A method for manufacturing an organic light-emitting display apparatus, the method, comprising:

forming a first electrode;

forming an organic layer on the first electrode by depositing organic material through a patterning slit sheet frame assembly, the patterning slit sheet frame assembly including:

a patterning slit sheet having a pattern;

a patterning slit sheet frame supporting the patterning slit sheet; and

a tensile force application unit that applies a tensile force to the patterning slit sheet after the patterning slit sheet is disposed on the patterning slit sheet frame,

wherein an entirety of the tensile force application unit is closer to a center portion of the patterning slit sheet than is a location where the patterning slit sheet and the patterning slit sheet frame are attached to each other; and

forming a second electrode so that the organic layer is interposed between the first electrode and the second electrode.

3. The method of claim **1**, wherein the tensile force application unit applies force to the patterning slit sheet only in a direction orthogonal to which tensile force is applied to the patterning slit sheet, while the patterning slit sheet and the patterning slit sheet frame are connected to each other.

4. The method of claim **1**, wherein the patterning slit sheet includes a center portion where a patterning slit is formed and an outer portion where the pattern is excluded.

5. The method of claim **4**, wherein the tensile force application unit contacts the outer portion to surround the center portion of the patterning slit sheet.

6. The method of claim **4**, wherein the patterning slit sheet frame has a pillar shape having a penetrating portion corresponding to the center portion.

7. The method of claim **6**, wherein a top surface of the patterning slit sheet frame is connected to the outer portion and the center portion is exposed by the penetrating portion.

8. The method of claim **6**, wherein the tensile force application unit is on an inner surface of the patterning slit sheet frame and a top surface of the tensile force application unit contacts the outer portion.

9. The method of claim **8**, wherein the tensile force application unit is movable only in directions orthogonal to which tensile force is applied to the patterning slit sheet.

10. The method of claim **9**, wherein the tensile force application unit applies the tensile force to the patterning slit sheet

by applying force to the patterning slit sheet only in a direction orthogonal to which tensile force is applied to the patterning slit sheet.

11. The method of claim **8**, wherein:

there are n tensile force application units, where n is a natural number, and

an (n)th tensile force application unit is on an inner surface of an (n−1) th tensile force application unit.

12. The method of claim **8**, wherein the tensile force application unit is formed separately on the inner surface of the patterning slit sheet frame.

13. The method of claim **6**, wherein the patterning slit sheet frame includes an accommodation groove that accommodates the tensile force application unit therein.

14. The method of claim **13**, wherein the tensile force application unit is inside the accommodation groove and the accommodation groove is covered by the outer portion.

15. The method of claim **14**, wherein:

the tensile force application unit is movable only in directions orthogonal to which tensile force is applied to the patterning slit sheet inside the accommodation groove, and

the tensile force is applied to tighten the patterning slit sheet as the tensile force application unit protrudes outside the accommodation groove and applies force to the patterning slit sheet only in a direction orthogonal to which tensile force is applied to the patterning slit sheet.

16. The method of claim **13**, wherein there is a plurality of the accommodation grooves and the tensile force application unit is within each of the plurality of accommodation grooves.

17. The method of claim **16**, wherein the plurality of accommodation grooves are spaced apart from each other in a receding direction from a center point of the patterning slit sheet.

18. The method of claim **13**, wherein there is a plurality of the tensile force application units, and each of the plurality of tensile force application units comprises an accommodation portion for accommodating the other tensile force application unit.

19. The method of claim **18**, wherein:

there are n tensile force application units, wherein n is a natural number, and

a first tensile force application unit is accommodated in the accommodation groove, a second tensile force application unit is accommodated in an accommodation portion of the first tensile force application unit, and a (n)th tensile force application unit is accommodated in an accommodation portion of a (n−1)th tensile force application unit.

* * * * *